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Memoirs of the Department of Agriculture in India

THE BIG BROWN CRICKET

(*BRACHYTRYPES ACHATINUS*, STOLL.)

BY

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Assistant to the Imperial Entomologist

AGRICULTURAL RESEARCH INSTITUTE, PUSA

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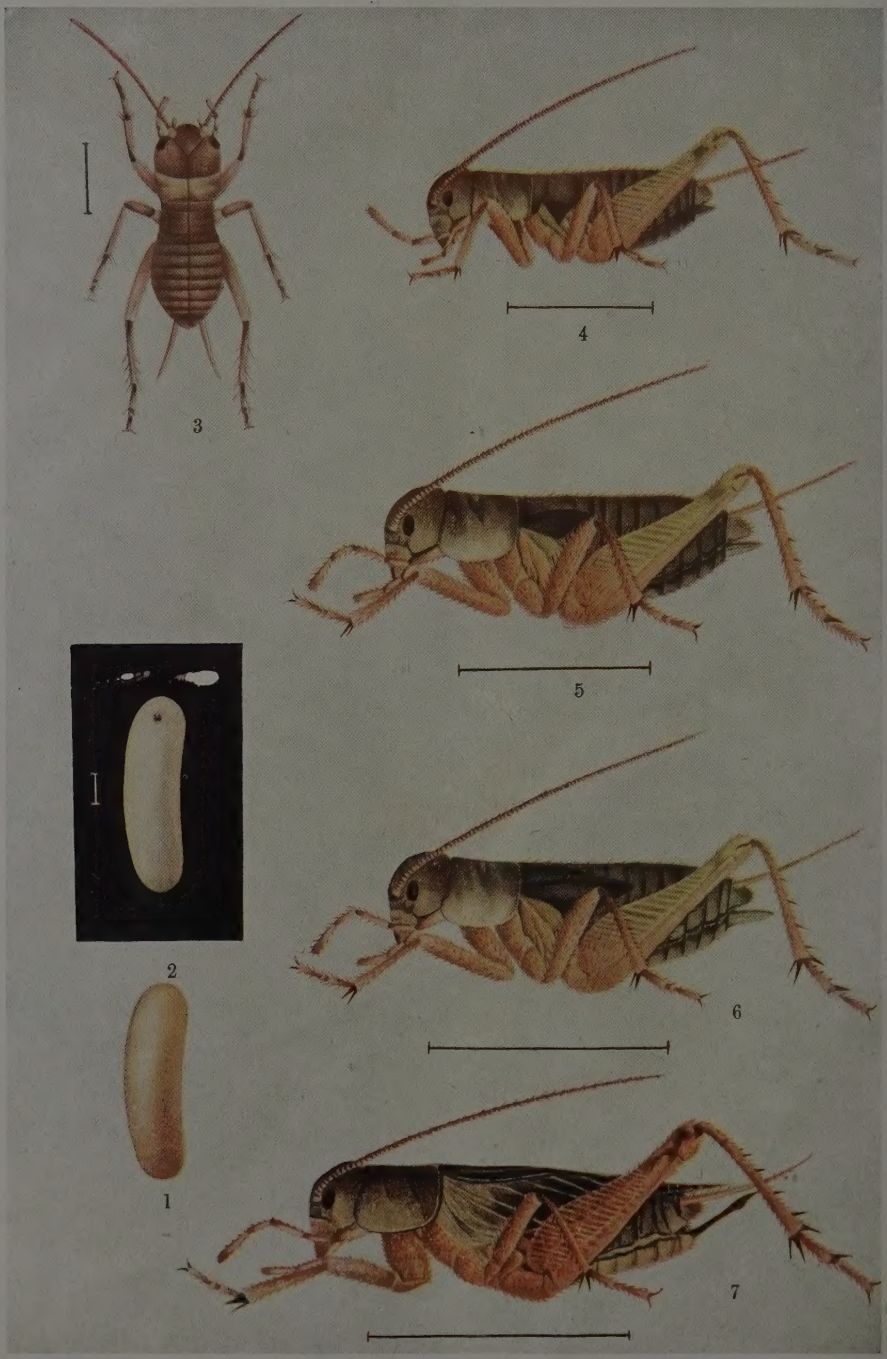

THE BIG BROWN CRICKET.

(*Brachytrypes achatinus*, Stoll.)

EXPLANATION OF PLATE X.

The Big Brown Cricket.

(*Brachytrypes achatinus*, Stoll.)

Fig. 1. Egg when laid.
„ 2. Egg before hatching.
„ 3. Young nymph, dorsal view.
„ 4. Nymph in the third stage, side view.
„ 5. „ „ „ fourth „ „ „
„ 6. „ „ „ fifth „ „ „
„ 7. The adult cricket, side view.

(The hairlines indicate the actual sizes of the stages).

THE BIG BROWN CRICKET.

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Assistant to the Imperial Entomologist.

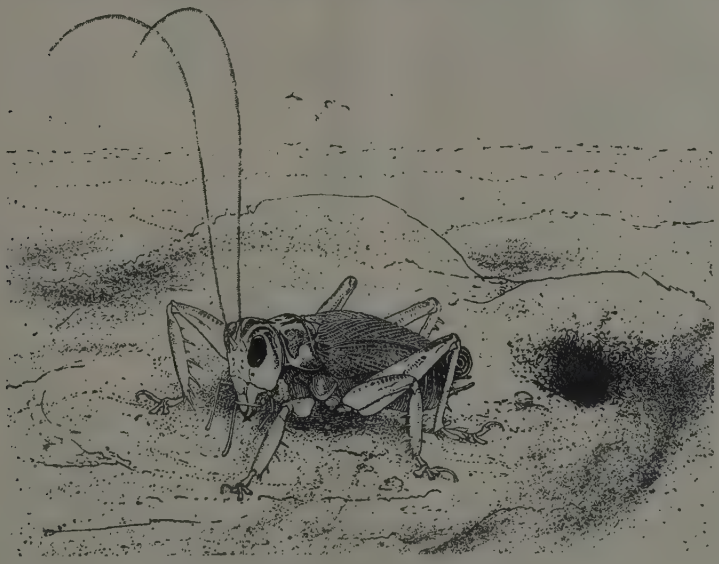
THE large brown cricket (Plate X) (*Brachytrypes achatinus*, Stoll.) belongs to the family Gryllidæ of the saltatorial (jumping) group of the Order Orthoptera. It is a large insect measuring about $1\frac{3}{4}$ inches from head to tail and is about $\frac{1}{2}$ inch thick across the thorax and the abdominal region. The antennæ are thread-like and about as long as the body. The colour is brown. The inner parts of the forewings, or tegmina, lie flat on the back, their outer parts being bent at right angles down the sides. The hind wings are like thick membranes and remain folded longitudinally and hidden under the forewings, which overlap each other on the back. In the majority of cases the left tegmen is above the right one, but the reverse arrangement is also found in both the sexes. The hind legs are much bigger than the first two pairs and are suited for jumping, their femora being very thick and broad and the tibiæ spiny on the posterior side. On the hind end of the body there is a pair of cerci more than $\frac{1}{2}$ inch long. The head is deflexed so that the mouthparts are turned downwards. The mouthparts are conspicuously developed, the mandibles being very large and powerful. The eyes are black and prominent. The females possess a long ovipositor pointing posteriorly and upwards. There is a pair of tympana on each fore-tibia near its junction with the femur.

OCCURRENCE AND DAMAGE.

These crickets are probably widely distributed throughout India. They work at night; therefore their presence is not

always detected, and the damage they cause is in most cases attributed to wrong sources. They have been noted in Comilla (Jute and Rice); Sikkim; Assam (Tea); Sibsagar; Jorhat; Khasi Hills; Murshidabad; Calcutta; Sadeya; Isubu; Mongomalobah; Solanah; Pusa; Bankura; Patna; Champaran (Indigo); Bogra; Dacca and Rungpur. In June 1893 they were reported as damaging jute and rice in Comilla. In July of the same year much damage caused by them to teaplants in nurseries was reported from Jorhat. They cut the young plants off level with the ground at night. They were reported making burrows from 9 to 18 inches deep in the ground specially in sandy soils and concealing themselves during the daytime; they sat at the mouth of the hole in the evening and could be recognised by their shrill piping. (Indian Museum Notes, Vol. III, No. 5, pp. 77-78). In 1903, the Deputy Director of Forests, Myitkyina, Burma, reported damage caused by these crickets in gardens and nurseries. In April 1906 the Collector of Bogra reported damage to jute which he said had commenced from about the 3rd week of March; the insects appeared there every year, but usually disappeared as soon as the rains set in. In April 1907, the Collector of Dacca reported similar damage to jute and rice which had commenced early in March. In April 1910, Babu Baidya Nath Tarafdar of Pubna in reporting the occurrence of these crickets said: "These insects are causing serious damage to young jute plants; whole fields have been destroyed and seeds have been resown two or three times in some cases, but still without success. When the plants grow to a height of about 9 inches they are more or less immune. The insects are numerous and live underground in burrows which they dig in the fields. They come out at night and cut down the plants, eating some and dragging some into their underground nests.....They are not so common in lands having enough moisture in the subsoil and are found in large numbers in those having hardly any moisture to the depth of about 9 inches below the surface. They also occur in loamy soils. All these lands are usually flooded in the rains."

In April 1911, it was reported from Jelhara Indigo Concern in Champaran that the cultivation of indigo was being ravaged by an army of *bherwas*. The destruction they caused was described as appalling. They totally destroyed plants 6 inches to 9 inches high. At this time indigo was the only green food available to them and therefore the damage was very great. In one village out of 45 acres of indigo worth about Rs. 40 to Rs. 50 per acre, 25 acres was utterly destroyed. The same habit of nocturnal feeding was reported here as well. On later enquiry



BHERWA.—(SCHIZODACTYLUS MONSTRUOSUS).
(From Indian Insect Life).

it was ascertained that the damage was caused by the large brown crickets and not by *bherwas*. What are known as *bherwas* in Behar are quite different insects as will appear from the figure. They are greyish yellow and not red brown. The wings of *bherwas* are peculiarly coiled at the end and the tarsi of their legs are peculiar. They are bigger and more weird looking insects than the large brown crickets. They also live in underground burrows like these crickets, but they are found principally in sandy beds of rivers and are not so common, though

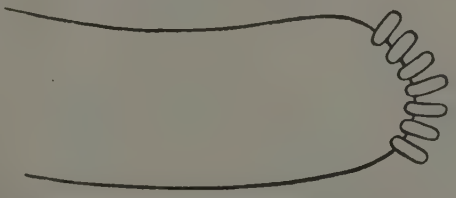
not altogether rare, in cultivated fields or high lands. They have not been observed to feed on a vegetable diet and therefore to damage any plants in the way the large brown crickets do. In confinement also they have not fed on leaves, etc., but have greedily fed on caterpillars and frogs. Most probably they are predaceous on other insects, etc. Therefore it appears that the reports in Indian Museum Notes, Vol. II, No. 6, p. 172, and Vol. III, No. 4, p. 46, about *bherwas* cutting tobacco, indigo and other crop plants, are based on mistaken observations. The damage is attributable to the large brown crickets. It is however possible that the *bherwas* may damage plants by tunnelling through the soil and cutting through roots which obstruct their passage ; but any such damage seems to be accidental rather than normal.

LIFE HISTORY.

The big brown cricket (*Brachytrypes achatinus*, Stoll.) passes through only one cycle in the course of the year. Eggs are laid in burrows under the ground about the month of September just after the rains have ceased. They hatch in about a month. The habits of the crickets are well described in the reports of occurrence noted above. Throughout their life they live in burrows which they dig in the ground. They are nocturnal in habit and come out of their underground burrows only at night when they feed or collect food which they carry into the burrows. They possess very powerful cutting jaws with which they shear through the stems of almost all kinds of young plants which are then carried off. In this way they sometimes cause incalculable damage to young crops. The young crickets are similar to the adults in appearance ; only they are small and possess no wings. They grow, moulting at intervals and developing small wings in the later stages as will be evident from the figures of different stages in the plate. They become adult when the wings are fully developed. Some grow more quickly than others and attain the fully winged adult stage about April. The majority become adult by June ; while yet a few may be found in the

nymphal stage as late as August. In spite of the early development mating and egg-laying do not take place until the proper season in September—October. The adult crickets die after laying eggs ; occasionally one may survive till late in winter ; thus, for example, one adult female was found on 4th December at Rungpur among myriads of young nymphs. In winter the crickets are young, but by March they are sufficiently large to cause serious damage to newly started crops. Hence almost all the reports noticed above are found to have been made about the month of April. Then, as will be seen later on, the first heavy shower of rain brings about, directly or indirectly,* the death of many, while the surviving ones have to leave the flooded or submerged places and therefore also the crops standing in those places.

Egg.—Each egg is about 4-6½ m.m. in length, the eggs laid in the same cluster being variable as to length and about 1½ m.m. in diameter. The egg is cylindrical in shape with rounded ends. It is a little curved on one side, the back of the enclosed embryo lying against the concave side. The surface is smooth and without ornamentation ; the colour is yellow, turning creamy white later on (Figs. 1 and 2, Pl. X), the two eyes of the embryo being clearly seen as dark spots in the advanced state. Eggs removed from the soil and kept exposed to the atmosphere turned greyish in colour ; before hatching also they turn greyish ; (Fig. 2, Pl. X). At this time if looked at carefully the segments of the body of the embryo are discernible. The eggshells are thin, membranous and soft. The



A diagrammatic illustration to show how the eggs are laid at the end of the burrow.

* Rain is destructive to the crickets by flooding their tunnels and driving them out into the open where they are eagerly preyed on by almost every one of the larger birds which is normally or occasionally insectivorous. Crows, Shrikes, the Blue Jay, the Hoopoe, the King Crow, Cuckoos, Owls, Hawks and Kingfishers may be mentioned in particular, and the irrigation of a field about April usually attracts enormous numbers of these birds to devour the crickets which are then perforce compelled to desert the security of their subterranean burrows.—T. B. F.

eggs are laid in a cluster at the end of the burrow underground. For the purpose of depositing eggs the hole is always made to end in hard soil. Each egg is thrust separately into the soil, so that the eggs do not touch one another. In the Insectary two clusters were found at a depth of about 2 feet and one at a depth of about 1 foot. In a single hole only one cluster of eggs was found. Of the three clusters found in the cage in the Insectary :—

(1) One contained 38 eggs.

(2) The second one contained 37 just hatched young ones and one unhatched egg.

(3) The third one contained 34 eggs, but there were probably more as a few eggs of this cluster were destroyed while being dug out.

Several adult females were kept confined separately in glass troughs filled with earth ; the troughs were emptied at intervals and the earth examined for eggs. One female laid 47 eggs between 10th and 15th September. Probably on account of frequent disturbance these eggs were not deposited all in the same fashion as shown in the diagrammatic illustration. Some were found thrust into the earth, while others were lying loose in the burrow among loose earth.

It seems that the small number of eggs found in the burrows in the Insectary does not represent the possible number which may be laid by a female. In the second week of August several females captured at random were dissected and each of the two egg masses, one on each side of the abdomen, seemed to contain about 40 to 45 eggs. At this time the eggs were small, the biggest measuring about 3·5 m.m. ; all were cylindrical and elongate oval in shape and provided with a cylindrical tapering tail. The colour was whitish. In the second week of September several females similarly captured at random were again dissected. The egg masses were now much bigger, on account of the development of the eggs, many of which were of the same shape, size and colour as those actually deposited in the soil. These developed eggs were seen to have

lost the tail. In the same cluster there were many other eggs which were not yet completely developed and had the tail; they were in different stages of growth and were, therefore, of different sizes. It thus seems that the female does not deposit all the eggs in the same cluster and at the same time; if after the first oviposition she lives and the immature eggs have time to develop, she can deposit eggs again. The egg masses at this time were found to contain many more eggs than in August. The following are the numbers found in 4 females :—

(1)	Right	cluster	103	of which	54	seemed	mature.
	Left	„	97	„	49	„	„
(2)	Right	„	89	„	41	„	„
	Left	„	95	„	40	„	„
(3)	Right	„	110	„	63	„	„
	Left	„	102	„	52	„	„
(4)	Right	„	106	„	76	„	„
	Left	„	102	„	81	„	„

Further observations about oviposition and other facts connected with the hatching of eggs in the natural condition could not be made. In the case of the eggs removed from the burrow the young ones hatched by bursting the shell at the head end; either the end was opened like a cap on the head and the shell burst longitudinally to some extent on one side from the opening thus made, or there was only one fissure longitudinally which extended for some distance down the side. In most cases the delicate inner skin (oölemma) stuck to the empty shell as a small crumpled mass by means of a thin thread; in a few cases it stuck to the emerging young nymph and was thrown off separately. The eggs laid between 10th and 15th September began to hatch on the 16th of the following October and continued to hatch till the 25th October.

Stages.—In all the stages of growth the crickets retain a remarkable similarity of appearance, general shape and also of colour. Males and females are distinguishable from the early stages, as in the females the ovipositor is present in these stages and grows with the growth of the insect.

As the nymphs live in burrows underground it has not been possible to observe their moults accurately. Several were kept in glass dishes filled with earth and a watch kept on them. They, however, did not get on so well and only one survived to attain the adult stage. It cast five skins in all, as was evident from the changes of appearance. The approximate dates are given below. The habit of eating the cast skins rendered the observation of moults still more difficult.

The young one hatched out in the cage—10th October.

First moult	...	...	...	... 19th November.
Second ,,	...	...	...	... 27th January.
Third ,,	...	...	...	... 21st March.
Fourth ,,	...	...	...	... 7th May.
Fifth ,,	...	...	...	... 15th June.

At the fifth moult it attained the adult stage. It was a male.

1*st Stage*.—Young nymph—(Fig. 3, Pl. X).

Young nymphs vary in size in the same manner as the eggs do. A newly hatched young nymph measured about $4\frac{1}{2}$ m.m. from head to hind end and about $1\frac{1}{2}$ m.m. across head and abdomen. The antenna was about as long as the body.

A young nymph about four days old measured as follows :

Length from head to hind end—8 m.m.

Breadth across head, prothorax and middle of abdomen—about $2\frac{1}{2}$ m.m.

The anterior part of abdomen is narrower.

Antennæ, about 8 m.m. long, thread-like and thick at the base and gradually tapering towards the end, made up of numerous small joints and covered with very minute hairs.

There is a pair of cerci—about 3 m.m. long—at the hind end of the abdomen pointing posteriorly.

The general colour is light brown, the abdomen being paler and showing a dark tinge in the middle. In general appearance and shape the young nymph resembles the adults, only it is small and possesses no wings.

The pronotum is big. The segments of the body are clearly distinguishable.

2nd Stage.—

Length from head to hind end	14 m.m.
Breadth across head and anterior part of prothorax ...	5 m.m.
Breadth across abdomen	4·5 m.m.
Antennæ about	15 m.m.
Cerci about	4·5 m.m.

There is hardly any change in appearance and colour except that the abdomen is slightly darker.

3rd Stage.—(Fig. 4, Pl. X).

Length from head to hind end	24 m.m.
Breadth across head and anterior part of prothorax ...	8 m.m.
Breadth across abdomen	7·5 m.m.
Antennæ	25 m m
Cerci	8 m m.

In general appearance and colour the nymph has hardly undergone any change.

Laterally the mesonotum and metanotum show a small elongation which is really the beginning of the formation of the wingpads.

4th Stage.—(Fig. 5, Pl. X).

Length from head to hind end	29 m m.
Breadth across head and anterior part of prothorax ...	9 m.m.
„ „ abdomen	8·5 m.m.
Antennæ	30 m.m.
Cerci	9 m.m.
Mesothoracic winglobes	3 m.m.
Metathoracic „	4·5 m.m.

The winglobes lie lengthwise and flat on the body. There is hardly any other change.

5th Stage.—(Fig. 6, Pl. X).

Length from head to hind end	33 m.m.
Breadth across head and anterior part of prothorax ...	9·5 m m.
„ „ abdomen	9 m.m.
Antennæ	32 m.m.
Cerci	9·5 m.m.
Lobe of tegmina	6 m.m.
Lobe of hind wings	9 m.m.

The tegmina only touch each other over the back. All the lobes lie flat and lengthwise along the body.

6th Stage.—(Fig. 7, Pl. X).

When reared in confinement the size of insects varies a great deal and is usually smaller than is the case when they live and feed freely. But the size of the brown crickets is seen to vary a great deal even when they live in the open free condition. The following are the measurements in m.m. of a few adults reared in the Insectary :—

From head to hind end.	Across the prothorax.
♀ —30	11
♂ —31	11
♂ —36	12
♀ —39	13

The following are the measurements in m.m. of some adults captured in the fields :—

♀ —26	9
♀ —27	9
♂ —32	11
♂ —37	12
♂ —37·5	12·5
♂ —38	13
♀ —38	12
♂ —39	1·25
♂ —39	13
♂ —40	13
♀ —42	13
♂ —42	13
♀ —46	13

In the same way the nymphs in all the stages vary a great deal in size.

The measurements of other parts of the last female captured in the field are the following :—

Antennæ	44 m.m.
Across middle of abdomen	14 m.m.
Cerci	14·5 m m.
Ovipositor	9·5 m.m.

The measurements of the parts vary according to the size. A general description of the adult insect has been given in the beginning. The modification of the tegmina of the males for the production of sound has been noticed under the heading "song." The adult crickets have never been observed on the wing and their wings are very small for their bulk. They take long jumps, their hind legs being very well developed.

FOOD.

The big brown crickets seem to be omnivorous. They can feed and live on the leaves and sometimes the fruit of almost any kind of plant. They have been fed in the Insectary with the shoots and leaves of the following, *viz.*, ground-nut, mangold wurzel, tobacco, lucerne, sannhemp, castor, sunflower, brinjal, arum, bottlegourd and cucumber. They were given and ate pieces of bread and a bait prepared with fine wheat chaff, molasses and water. They have been reported to damage rice, indigo, tea and jute and various garden plants. What they eat can be very easily found out by digging open their burrows into which they are in the habit of carrying their food. The following were found in some burrows dug out in the Insectary compound (leaves, etc., found in the same burrow are noted separately; the plants were available in the compound and the leaves, etc., were more or less eaten) :—

(1) Dry *sissoo* leaves partly eaten. green *dubh* grass *(Panicum dactylon).*

(2) *Mutha* grass *(Cyperus rotundus Linn).* Loranthus leaves, about half eaten. Mango leaf, dry and partly eaten. Raw *ghurmi* fruit (cucurbitaceous) more than half eaten.

(3) Castor leaf.
Mango leaf, dry.
Shoot of *Dodonea viscosa.*

(4) Cotton leaf, dry.
Sissoo leaf, dry.

(5) Bottlegourd leaf, dry.

(6) Brinjal leaf, dry.
Sweet potato leaf.
(7) *Gular* leaf, dry.
Cucumber shoot.
(8) Young sunflower shoot.
(9) Young marigold shoot.
(10) Young shoot of *Celosia cristata.*
(11) Mulberry leaf.

Note :—I have also found stones of litchi fruit in their burrows.—T. B. F.

Feeding.—The crickets do not seem to climb upon any plants but cut and carry away what they can get at on the ground. Among the things found in their burrows were fallen and also dry leaves which they found lying on the ground. Young plants they cut just above the ground and either eat them on the spot or carry them into their burrows. When the plants grow tall they become safe. Thus it will be seen from the reports quoted above that when jute and indigo plants grow more than 9 inches high they are practically immune from attack. In the Insectary compound, brinjal, sunflower and cabbage seedlings which had been transplanted were found to have disappeared the next morning.

The following are some of the records of the feeding habits of these crickets as observed in the Insectary :

10th March.—Nymphs collected and put in the cage. Every afternoon shoots of lucerne were placed on the surface of the earth. The crickets came up at night and ate them and also dragged some shoots into their burrows. Small fragments of bitten leaves were found lying on the surface, so that evidently they had fed at night above the soil. Shoots almost entirely or partly eaten were found in the burrows on opening them up. The crickets probably feed at leisure in the burrows during the daytime.

Mangold wurzel, ground-nut, sannhemp and castor leaves were also eaten. Castor leaves appeared to be greatly appreciated. Sunflower leaves were also eaten, but castor leaves seemed

to be preferred to sunflower and were sometimes liked more than lucerne.

3rd June.—Sannhemp preferred to lucerne.

7th June.—Castor preferred to lucerne.

15th June.—Lucerne preferred to castor.

31st July.—All the crickets were fully winged and adult. The whole cage was dug out, but no eggs or young ones found.

On 27th August.—Eight shoots of lucerne and four pieces of bread were supplied to the crickets. On the next morning two shoots of lucerne and five pieces of bread were found missing, either eaten or taken under the earth.

30th August.—Cage searched; no eggs found.

31st August.—The crickets were supplied with ten shoots of lucerne and four balls of bait (each about 1 inch in diameter). The bait was prepared by mixing molasses, a little water, and the fine chaff obtained by passing coarse *ata* (wheat flour) through a fine sieve. No poison was added.

On the next morning two shoots of lucerne and one ball of bait had completely disappeared; two other balls were found half-eaten.

On 2nd September.—Eight shoots of lucerne and two balls of bait were supplied. On the next morning none of the shoots had been touched, but a little of one ball of bait had been eaten.

The same food was left in the cage, and on the following morning four out of the eight shoots had disappeared whilst the bait had not been touched any more.

On 5th September.—8 shoots of lucerne,
2 castor leaves,
2 balls of bait were supplied. On the next morning it was found that nothing except portions of the bait had been touched. The same food was left in the cage, and on the following morning the bait and one shoot of lucerne had disappeared.

On 8th September.—The crickets were given eight shoots of lucerne and two balls of bait, but on the next morning only a portion of one ball of bait had been eaten.

The same food was left in the cage, and on the following morning two shoots of lucerne and portions of both the balls of bait had been devoured.

20th September.—No eggs were found.

2nd October.—Young ones found in the field.

10th October.—Young ones hatched out in the cage. They were fed principally with shoots of lucerne. Other leaves, *e.g.*, brinjal, arum, and cucurbitaceous leaves were also supplied and they used to feed on them. The first one became adult on 15th June.

BURROWING

After hatching from the eggs the young crickets live for some time in the burrow of the parent. It is not known how long they live thus, but apparently it is not more than two or three days. After this they disperse and each makes a separate burrow for itself. These burrows can easily be located and the young cricket dug out as it lives within a distance of about 3 to 6 inches from the surface. Small particles of earth are thrown out in a heap over and round the mouth of the burrow, whose entrance is indicated by a slight depression about the middle of the heap. These small heaps of earth are quite characteristic and are extremely common about the latter half of October by which time the eggs hatch. The young crickets, like the grown up ones, come out at night in search of food, and it seems most of them do not find their way back to the old nest and have to hide themselves by making fresh burrows; in fact, all the small heaps of earth seem to be freshly thrown out when one sees them in the morning. Usually only a single young one is found in the same pit, which goes down at an angle and shows no ramifications. Gradually these heaps of earth are observed to diminish in number, evidently indicating a diminution in the number of the crickets themselves. As the crickets grow, the burrows have to be bigger and therefore more earth is thrown out; and they go down deeper and tend to be tortuous and may have ramifications; they never go down straight. Big burrows

also are easily located by the earth thrown up. The adult crickets do not seem to dig a fresh nest every night ; in a court-yard a male was noticed in August—September to sing sitting at the mouth of the same burrow, consecutively for 23 days, after which it was captured. Either they are capable of returning to their nests or take shelter in any burrow which they find ready at hand. Probably it is for this reason that sometimes two, three or four crickets, not necessarily of different sexes, are found in the same burrow ; but as a rule only a single cricket is found in one burrow. The first heavy shower of rain in April, May or June floods the burrows and drives out the crickets ; many are killed by crows and other enemies. They take shelter and hide in odd places, many coming into the houses ; this however is only a temporary habit ; they soon resume their subterranean existence and after this generally choose places which have not been flooded, places which have already been submerged being apparently considered to be ineligible sites. In the rainy season the crickets are mainly found in places which are directly under the shade of trees, but it cannot be determined what leads them to select such situations. At this time they rarely make fresh burrows but live in old ones, so that no earth is found heaped near the mouth, which is quite open and goes down obliquely. Almost all the burrows are tortuous and may possess several ramifications and occasionally more than one opening. One, two or three crickets may be found in the same burrow at this time of the year ; fresh burrows with earth thrown out are not however altogether rare on comparatively high lands.

The process of digging the burrow is actually carried out by the jaws, with which the earth is bitten and loosened and cut into small pellets. The loosened earth is then drawn under the breast and thrown out by the legs. This process is followed until when the earth can no longer be thrown out by the legs as the burrow gets deeper. The loosened earth is then pushed all the length of the burrow and out by means of the front part of the head.

These crickets excavate their tunnel in the ground in order to prepare a nest for themselves. They do not burrow on like the mole crickets: unlike the mole crickets also, they burrow deeper and the greatest depth noticed was about 3 ft., but it is frequently less. When the burrow is tortuous and has many ramifications, it may come up to quite near the surface in any part of its length.

The cricket can be dug out, as its hole is very easily traced; as the hole is dug it retreats and can be caught at the extreme end of its tunnel. Pouring water into the hole brings it out quickly. If a small pit is formed at the mouth of the hole and water remains collected there after the entire pit has been filled, the cricket cannot escape; it comes up and floats on the water as if dead. Evidently water affects it very quickly. When there is a heavy shower and burrows get submerged probably many are drowned and die in this way.*

From the mode of their life it is evident that the crickets cannot live in mud or muddy soils. They require a soil in which they can make a clear hole which they can enter or leave with ease.

SONG.

In loudness, shrillness and intensity of song† the big brown crickets excel all other insects, including the cicadas of the plains. Like that of the cicadas the song is continuous but more powerful and shrill. It is a long continued, high-pitched and uniform *Krirr-rr-rr-rr* of which the *r* is more distinct than the *n*. Very rarely there may be a slight variation in the pitch or the song may be stopped abruptly in the middle and begun again at the same pitch. Occasionally only somewhat prolonged chirpings are heard, but that only from individual crickets and at other times than that of general singing, *e.g.*, late hours

* (Still more are flooded out and fall a prey to birds and other enemies.—T. B. F.).

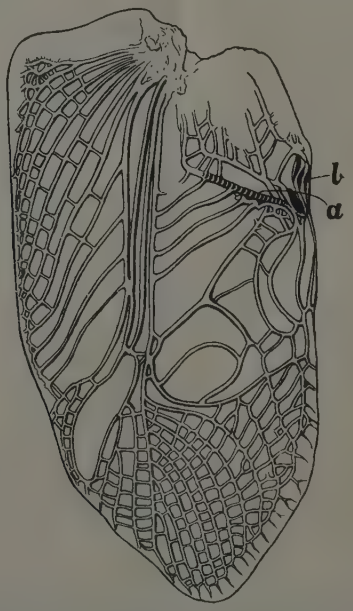
† The term song is rather a misnomer. The noise produced is a continuous high-pitched shrill vibrant whistle which at close quarters positively makes one's ears ring for a considerable time afterwards. I can only like the noise to that of a "devilene" whistle.—T. B. F.

of the night or early hours of the morning. The cicadas in the plains delight in singing when the midday sun shines hot in summer. The crickets rarely sing at this time of the day. They usually begin when the day draws to a close and continue till a late hour in the night. Some may not sing early in the evening, being noticed to begin as late as 11 P.M. The season of their song commences with the close of the rains ; when the song of the big brown crickets becomes general it is an unfailing indication of the rains being at an end ; this fact has been observed consecutively for four years at Pusa. At this time the song is heard in all kinds of places, not even the courtyards of houses being excepted. All sing during the evening, but individual ones may be found singing in the morning or any time of the day and night. Before the proper season commences an occasional song may be heard from about the month of April, but it is by no means common.

It is the male crickets which sing ; the females are not capable of producing any sound and are "voiceless" like "Cicadas' wives."* The wing covers or the tegmina of the males are modified for this purpose. On the under surface of each wing cover, on the portion of it lying on the back, a vein towards the base is raised and provided with a number of small ridges, thus becoming a sort of a file. On the upper surface the position of this vein is marked by a depression across the wing covers. Also a small part of the outer margin of ea 'i wing cover is so modified as to present a stiff raised edge, by the margin being bent down at an angle. The sound is produced by the rubbing of the file of one wing cover over the raised edge in the margin of the other ; the length of the file is at right angles to the length of the rubbing edge. The sound is capable of being produced by both the tegmina and the provision of the sounding organ in both seems to be due to the irregularity noticeable in their arrangement on the back ; usually the left tegmen lies above the right, but

* It was a Greek philosopher who said "Happy the Cicadas who have voiceless wives."—T.B.F.

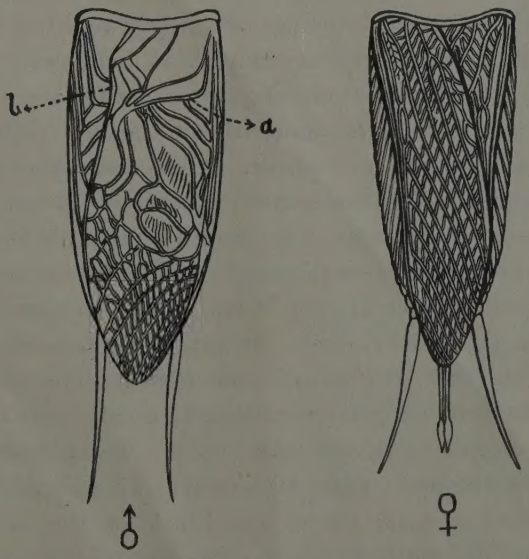
the reverse arrangement is not uncommon. The outer half of each tegmen is bent down the side and the rest lies along the back; therefore each tegmen is comparable to a thin concave metallic pot. When the sound is produced the tegmina are raised from the body and vibrated laterally at an extremely rapid rate, and the wings lie on the back as in the natural condition. As the tegmina are raised the sound is not dulled as it would be if they remained in contact with the solid body.



The under surface of the right tegmen of a male showing (*a*) the file, and (*b*) the modified portion of the edge which rubs the file of the other tegmen.

The cricket comes up from its underground burrow, sits just at the opening with the head turned towards the hole and the body away from it, and then pours forth its song. In the beginning there are usually one or two chirps and then it is one continuous song. The chirpings are produced by convulsive lateral movements of the tegmina in the same way as the song, in which the movements are very rapid and continuous. The song is

stopped at the sound of footsteps or the dropping of a stone and the insect quickly disappears into the burrow. It can, however, be stalked while singing if approached noiselessly. One was thus approached on tiptoe with a lantern in hand at 9 P.M. It was singing loudly and was so much absorbed in the song that it paid no heed to the approaching light which was placed at a distance of about one inch only. The light was carried steadily in such a way that it did not cast shifting shadows of the surrounding balsam and rose plants. The cricket went on singing. The tegmina were raised up from the body, forming an angle of about 60° and the wings were lying on the back. In the middle, the song was stopped for about a quarter of a minute and then commenced again. When the song was stopped the tegmina were still held raised in the same position as when singing. After about five minutes more the song was stopped again when the cricket discovered that there was a light quite near and it at once slipped into the hole, the tegmina being brought down at the same time. The light attracted two large toads, and although



The back of a male and a female.
(*a*) the vein with file ; (*b*) the rubbing edge.

they came quite near the cricket, they showed no hostile attitude towards it. Many were similarly approached afterwards, and it was found that the tegmina were held raised up to form an angle of 45° to 60° with the body while singing.

It is said that the males sing in this manner in order to charm and attract the females, and it is significant that the season of their song is the season for mating and egg laying. Soon after this merry nuptial period they die.

The tegmina of the females are smooth compared with those of the males. Leaving aside the long ovipositor which marks the females, the sexes in the adults can be distinguished by looking at the tegmina alone.

ENEMIES.

A small mite is found on the body under and near the base of the wings of the adult crickets which, however, do not seem to be inconvenienced appreciably on this account.

On 5th May a species of Mabuia (a Scincid lizard) was seen attacking a nymph of the 5th or penultimate stage at about 3 P.M. ; the cricket was trying to jump away but it was too much maimed and could clear only short distances ; the Mabuia was running after it and inflicting bites on the legs and body. It was an unusual hour for the cricket to be out. Most probably it was chased out of its burrow. Ultimately the cricket was dragged into a bamboo bush, and it as well as its assailant could not be traced any longer. It is quite probable that a certain number of the crickets are disposed of in this manner.

The metallic green Digger Wasp, *Sphex lobatus*, is frequently seen to prey upon this cricket. It enters the hole of the cricket and drags it out. The prey is made insensible by a sting and buried in some conveniently near hole or crack in the soil, after which the wasp lays an egg on its body. The phenomenon of a cricket being dragged by the Digger Wasp is common, especially in the dry, hot months before the break of the monsoon. It could not be determined how far the wasp is a check on the increase of the crickets.

When the crickets are driven out of their burrows by the first heavy rain during the day-time, a large number of them are disposed of by crows and numerous other birds. During the night also, owls and other predaceous nocturnal birds and animals, prey on them when they come out of their burrows and roam about in search of food.

But with all these checks the Large Brown Cricket is a field and garden pest of the first magnitude.

PREVENTIVE AND REMEDIAL MEASURES.

The most vulnerable point in the life of the large brown crickets is when the first heavy shower of rain in April, May or June drives them out of their burrows. One year the first heavy shower fell about 10 o'clock in the morning and the Insectary compound became strewn, as it were, with the brown crickets. Two kerosene tins full were collected in the course of about half an hour by four men. A dip in the water made them sluggish and they were not jumping, but were either walking or running. A better method is to beat them with a broom, one effective stroke of which is sufficient to kill them. More can be killed in this way than can be collected in the same space of time. Besides some skill is required to catch them or they bite when caught and may cut through the skin ; even when caught with skill by the neck they kick with their hind legs whose spines prick and scratch the skin. They should be attacked as soon as they are driven out because they run about in search of hiding places and soon disappear from view. Crows pick out many, but the majority escape ; if it rains heavily, as happened on the occasion referred to above, they are hardly attacked by crows, which are deterred by the rain. The same effect is produced if their nesting place can be artificially flooded. They quickly come out of their burrows and should be beaten to death with brooms ; but flooding is not always practicable.

Digging out, or pouring water in every hole is a very tedious and expensive process although the insect can be

destroyed in every case; treatment of the holes individually in any way is impracticable.

From the records of their feeding in the Insectary it seems probable that they can be killed by poisoned baits, which may either be green shoots or leaves dipped in a strong poison, or *bhusa* prepared in the following manner. The baits should be placed here and there near and among the holes.

Bhusa	...	1 md.
Sambul (white arsenic)	...	1 seer.
Gur	...	2 seers.
Water	...	enough to make all these into a paste.

But the baits should be used judiciously in order to produce any effect at all. The best time would be March or a little earlier, before any crop is sown. If there be weeds growing they should be cleared off and so also fallen leaves, even though dry, of any big tree which may be standing near the place. Thus the crickets may not be diverted and all will surely take the bait. Another method would be to spray with a strong poison all the weeds and young and low vegetation. But this will not be as cheap and as effective as when the weeds are cleared off and the limited amount of poisoned food only remains available to the crickets.

In a garden the simplest plan would be to keep watch for fresh burrows, and if noticed early before they go down very deep, the crickets can be driven out with only a little water and without digging. In a courtyard eight crickets were driven out with less than half a kerosene tin of water. The burrow need not be actually flooded. The heaped up earth is pushed aside and water is poured into the hole; the cricket comes near the mouth where its head is visible, but does not leave the hole. Now a *khurpi* is plunged a bit obliquely into the earth either to cut the cricket or intercept it.